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Feeding of different Mulberry Varieties and its Impact on Silk Gland of Silkworm, *Bombyx mori* L.

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ABSTRACT: The mulberry varieties play an important role for the growth and development of silkworm, *Bombyx mori*. The good quality mulberry leaves produces excellent growth of silk gland of silkworm, which yields good silk both qualitatively and quantitatively, which finally reflects in the production of good cocoon crop. The research trial was conducted at Division of Sericulture Crop Improvement, College of Temperate Sericulture, Mirgund, SKUAST-Kashmir during spring seasons. The three mulberry varieties namely Kokuso-21, SKM-33 and Goshoerami were fed to silkworm right from brushing upto spinning of cocoons. Besides one control was also maintained throughout rearing period. On the 5th day of fifth instar silkworm larvae were taken and dissected to remove silk gland for recording of silk gland weight, tissue somatic index, silk conversion index and silk productivity. Among these tested mulberry varieties highest silk gland weight (1.965 g) was recorded in Goshoerami fed silkworm batch. Furthermore, highest silk productivity (5.433 cg/day) and silk conversion index (21.8 %) was recorded in Kokuso-21 fed silkworm batch. The tissue somatic index did not show any significant difference after fed on different mulberry varieties.

Keywords: Feeding, mulberry varieties, silk gland, *Bombyx mori*.

INTRODUCTION

Mulberry leaves are the sole food of the silkworm, *B. mori*, which is an economic insect (Gautam *et al*., 2022) of prime importance and also the quality of mulberry leaf has direct impact on overall growth and development of silkworm larva (Benchamin and Jolly 1986). Besides environmental factors, the silk productivity is dependent on the quality and quantity of the mulberry leaf (Nagaraju, 2002). Evaluation of mulberry varieties based on quality of leaf is the prime importance as the mulberry leaf constitutes 38.20 % alone for success of the silkworm rearing (Miyashita, 1986). Quality mulberry leaf acquires importance as 70% of silk proteins produced by the silkworm are directly derived from mulberry leaves (Fukuda, 1960). Lot of research has been done in the past and is currently carried out to increase the nutritional value by supplementation of mulberry leaves with different nutrients. The significant improvement in silk yield was reported (Islam *et al*., 2020a, 2022b, 2022c) after fortification of mulberry leaf with egg albumin. Also mulberry leaves account for 60% of total cost of cocoons (Rangaswami *et al.,* 1976). Nutritional value of mulberry leaf has an important role (Tantray *et al*., 2021) in the quality of silk production. It has direct effect on the silkworm growth and development, quality, yield and disease resistance of silkworms (Ito, 1961; Horie, 1980; Haque *et al.*, 1990; Krishnaswami and Venkataramu 1991). Mulberry varieties differ in leaf quality which ultimately influence silkworm rearing (Bongale *et al.*, 1997). Silkworm is a monophagous and domesticated insect which produces a silk fibre made up of fibroin and sericin. Silk gland growth of silkworm is of vital importance as it is necessary for silk protein synthesis, which is the basic raw material of cocoons (Sutherland *et al.*, 2010). The natural silk produced by the silkworms is originally synthesized in the silk gland of silkworm. Silk gland is an exocrine gland, paired modified salivary/labial glands situated on the two lateral sides under alimentary canal. Silk gland is actually tube made up of glandular epithelium with cells in two rows covering the lumen. Silk gland consists of three regions, anterior, middle and posterior parts measuring 2 cm, 7 cm and 15 cm respectively. Among these regions the anterior region being straight and short consists of 250 secretory cells and in this region the liquid silk proteins are processed, transported through spinneret and finally secreted.

Middle region is thick and in turn consists of three parts, fore, mid and hind part and contains 300 secretory cells which produce sericin. Feiying *et al*. (2005) analyzed the cells of middle silk gland of fifth instar larvae of *B. mori* at different stages of development. The posterior part is long and coiled and contains about 500 secretory cells which produce silk protein fibroin.

MATERIALS AND METHODS

The study was carried out at Division of Sericulture Crop Improvement, College of Temperate Sericulture, Mirgund, SKUAST-Kashmir in 2019 and 2020 spring seasons. The disease free layings of silkworm race (PAM-117) was incubated and brushed as per the standard rearing protocol (Anonymous, 2003). The rearing of said race was carried out from brushing till mounting on three different mulberry varieties *viz*., Kokuso-21, SKM-33 and Goshoerami and one control was also maintained for comparison. For each replication 100 larvae were maintained throughout the rearing. The following parameters were recorded and calculated by the formulae:

Silk gland weight (g). Fifth instar mature silkworm was dissected out dorsally and silk gland was taken out and weighed on digital balance to record the weight.

Tissue somatic index (%). This was calculated by the formula:

$$\text{Tissue somatic index} = \frac{\text{Silk gland weight (g)}}{\text{Mature larval weight (g)}} \times 100$$

Silk conversion index (%). It indicates the ratio of shell weight to silk gland weight and was calculated by the formula:

$$\text{Silk conversion index} = \frac{\text{Shell weight (g)}}{\text{Silk gland weight (g)}} \times 100$$

Silk productivity (cg/day). It gives an idea about the quantity of silk synthesized per day and was calculated by the formula:

$$\text{Silk productivity} = \frac{\text{Silk gland weight (g)}}{\text{5th age larval duration}}$$

Statistical analysis. The data was compiled and then analysed by following the standard method of Gomez and Gomez (1984).

RESULTS AND DISCUSSION

The mulberry varieties differed significantly with respect to silk gland weight. Highest (1.965 g) silk gland weight was recorded in Goshoerami fed silkworms, which may be due to the high protein content present in mulberry leaves, it was followed by Control (1.812 g) which was at par with Kokuso-21 (1.782 g). Lowest (1.693 g) silk gland weight was recorded in SKM-33 (Table 1) (Fig. 1). These results are in agreement with findings of Thulasi and Sivaprasad (2015), who found that nurtilite fed mulberry leaves influences on silk gland weight. Ahmad *et al.* (2009) also reported that thyroxine treated mulberry varieties namely, *Morus nigra* and *Morus multicaulis* effected the silk gland weight of the silkworm as compared to the control. It is also in conformity with the research findings of Bhatia *et al.* (2016) who studied the effect of seven tree species namely *Lagerstroemia speciosa, T. alata, L. tomentosa, T. arjuna, T. chebula, T. tomentosa* and *T. bellirica* on silkworm, *A. mylitta* with regard to silk gland weight in two rearing seasons (July-August and September-November) and found *T. alata* fed larva recorded significantly highest silk gland weight in first (8.03g) and second (9.47g) rearing seasons followed by *T. tomentosa.* It is also in line with the findings of Brahma *et al.* (2019) who studied the impact of vitamin C and E supplemented mulberry leaves on CSR2 × CSR4 with regard to silk gland weight and found highest silk gland weight (0.879±0.002g) in case of vitamin C fed mulberry leaves as compared to control. The tissue somatic index of silkworm did not showed any significant difference after fed on different mulberry varieties. Highest and lowest tissue somatic index of 48.74 % and 45.177 % was recorded however in Goshoerami and Kokuso-21 fed silkworms respectively (Table 1) (Fig 2). Similar findings were reported by Tantry (2017) who carried out study on supplementation of botanical and synthetic based ascorbic acid on silkworm hybrids, PM × CSR2 and CSR2 × CSR4 with regard to tissue somatic index and reported significant increase in tissue somatic index of hybrids as compared to control. The Kokuso-21 fed silkworms recorded highest (21.8 %) silk conversion index and differed significantly from other mulberry varieties. The higher silk conversion index may be because of increased shell weight after silkworms were fed on these mulberry leaves. Further it was followed by Goshoerami (18.5 %), Control (18.23 %) and SKM-33 (17.907 %) which were at par with each other (Table 2) (Fig. 4). It is in line with the findings of Rahmathulla and Naik (2017) who reported that antibiotic administered mulberry leaves impacts on silk conversion index of silkworm. The mulberry varieties differed significantly from each other with regard to silk productivity. Highest (5.433 cg/day) silk productivity was recorded in Kokuso-21 fed silkworms which was at par with Goshoerami (5.093 cg/day). The higher silk productivity may be because of increased silk gland weight which may be due to high protein content in mulberry leaves. Also lowest (4.235 cg/day) silk productivity was recorded in SKM-33 which was at par with Control (4.613 cg/day) (Table 2) (Fig 3). These results are in agreement with findings of Ahmed (2020), who reported highest silk productivity in case of K2 mulberry variety followed by K4, K5 and K1 varieties.

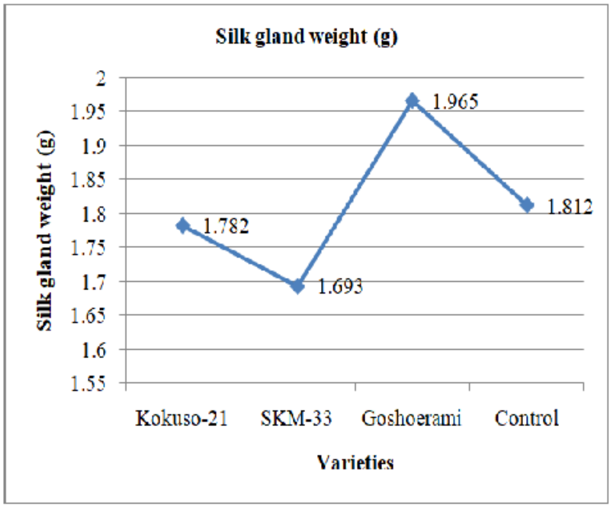

Fig. 1. Impact of different mulberry varieties on silk gland weight of silkworm *Bombyx mori* L.

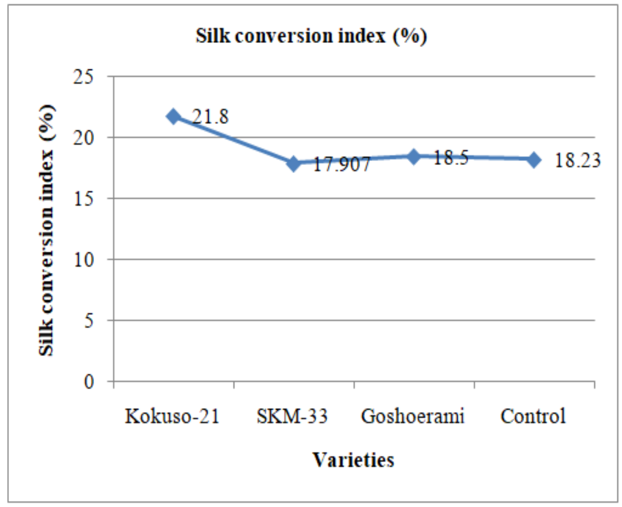

Fig. 3. Impact of different mulberry varieties on silk conversion index of silkworm *Bombyx mori* L.

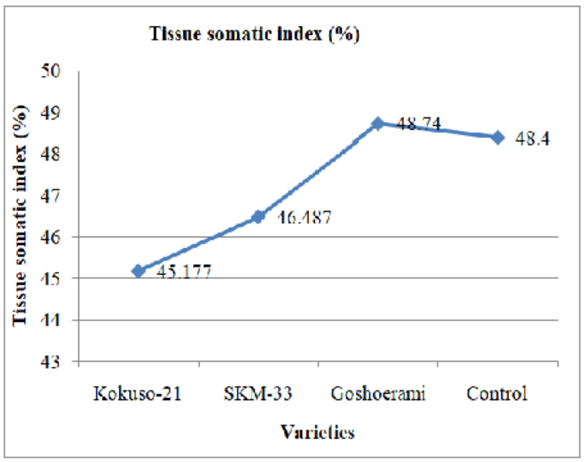

Fig. 2. Impact of different mulberry varieties on tissue somatic index of silkworm *Bombyx mori* L.

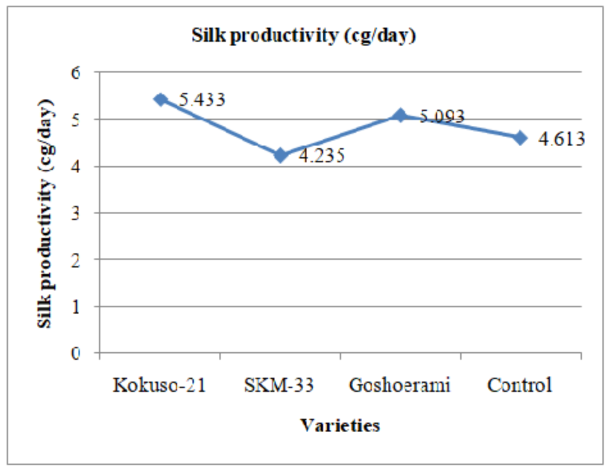

Fig. 4. Impact of different mulberry varieties on silk productivity of silkworm *Bombyx mori* L.

Table 1: Impact of different mulberry varieties on silk gland weight and tissue somatic index of silkworm, *B. mori* L.

Varieties	Silk gland weight (g)			Tissue somatic index (%)		
	Season (year)			Season (year)		
	Spring (2019)	Spring (2020)	Pooled	Spring (2019)	Spring (2020)	Pooled
Kokuso-21	1.757^{bc}	1.807^{b}	1.782^{b}	45.193	45.09^{b}	45.177
SKM-33	1.677^{c}	1.71^{c}	1.693^{c}	46.977	45.977^{b}	46.487
Goshoerami	1.967^{a}	1.963^{a}	1.965^{a}	48.833	48.563^{a}	48.74
Control	1.81^{b}	1.813^{b}	1.812^{b}	49.147	47.597^{ab}	48.4
CD ($p\leq$ 0.05)	0.1	0.079	0.084	NS	2.534	NS
SE (d)	0.043	0.034	0.036	1.414	1.082	1.195
C.V	2.896	2.261	2.42	3.643	2.832	3.1

Table 2: Impact of different mulberry varieties on silk conversion index and silk productivity of silkworm, *B. mori* L.

Varieties	Silk conversion index (%)			Silk productivity (cg/day)		
	Season (year)			Season (year)		
	Spring (2019)	Spring (2020)	Pooled	Spring (2019)	Spring (2020)	Pooled
Kokuso-21	22.023^{a}	21.583^{a}	21.8^{a}	5.413^{a}	5.453^{a}	5.433^{a}
SKM-33	17.89^{b}	17.923^{b}	17.907^{b}	4.187^{b}	4.283^{c}	4.235^{b}
Goshoerami	18.157^{b}	18.85^{b}	18.5^{b}	5^{a}	5.187^{a}	5.093^{a}
Control	17.507^{b}	18.95^{b}	18.23^{b}	4.427^{b}	4.8^{b}	4.613^{b}
CD (p≤ 0.05)	2.551	1.474	1.9	0.553	0.313	0.379
SE (d)	1.089	0.629	0.811	0.236	0.134	0.162
C.V	7.061	3.989	5.2	6.082	3.325	4.095

CONCLUSION

The nutritive value of mulberry leaf is an important factor for determining the success of silkworm rearing and cocoon formation. Quality mulberry leaves are found to incite the healthy growth of silk gland of silkworm, which finally produces good cocoon crop. The mulberry varieties varies in the biochemical constitution of leaves and therefore influences the growth and development of silk gland of silkworm differently. In the present study Goshoerami and Kokuso-21 varieties showed significant improvement in the parameters like silk gland weight, silk productivity and silk conversion index as compared to other varieties and control. The good performance shown by these varieties may be due to the increased nutrients in the form of moisture content, moisture retention capacity, proteins, carbohydrates, free amino acids etc present in the leaves of these mulberry varieties. Due to the high nutritive content in the leaves of these mulberry leaves, these can be utilized for the better growth of silkworms, which will result in the success of sericulture for silkworm rearers and uflift them economically. Keeping the above research findings in mind further experiments can be conducted to evolve more mulberry genotypes which will be more nutrition rich and will have more suitability as silkworm feed for silkworm rearing.

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Conflict of Interest. None.

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